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# Research Note

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## ESTIMATING LIGHT INTENSITY IN RESIDUAL STANDS IN ADVANCE OF CUTTING

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The use of partial cuttings in mature stands of the western white pine type introduces the need of a reliable yet simple method of estimating light intensity in residual stands in advance of cutting. This is of special importance where partial cuttings are used as a means of ribes suppression in blister rust control because success of suppression depends upon the amount of canopy reserved in cutting. It is also important in determining the probable course of forest regeneration following cutting; certain light intensities are favorable for regeneration of desired species and other intensities are unfavorable.

One method of estimating light intensity beneath the canopy is to relate it to measures of stand density. This was done on a number of sample areas in mature uncut and cutover stands of the western white pine type. Table 1 was prepared from these data relating light intensity to summation of diameters at breast height per acre. This relationship is given for three composition classes of stands. These classes are based on the percentage of small-crowned trees (western white pine, western larch, and Douglas-fir) in the total summation of diameters. A check of table 1 indicates that two out of three estimates obtained from it will be within 10 percent of the actual light intensity.

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Table 1 - Stand density equivalents for given light intensities beneath the canopy in mature stands of the western white pine type.

| Mean light intensity beneath the canopy 1/ | Overwood stand density as measured by summation of diameters per acre for stands composed 2/ of | | |
|---|---|---|---|
| | 0-33 percent small-crowned trees 3/ | 34-67 percent small-crowned trees 3/ | 68-100 percent small-crowned trees 3/ |
| (1) Percent | (2) Inches | (3) Inches | (4) Inches |
| 10 | 2600 | 3700 | 4000 |
| 15 | 1850 | 3000 | 3450 |
| 20 | 1650 | 2450 | 3100 |
| 25 | 1450 | 2100 | 2800 |
| 30 | 1300 | 1850 | 2550 |
| 35 | 1150 | 1650 | 2300 |
| 40 | 1050 | 1500 | 2100 |
| 45 | 950 | 1350 | 1850 |
| 50 | 850 | 1200 | 1650 |
| 55 | 750 | 1050 | 1450 |
| 60 | 650 | 900 | 1300 |
| 65 | 550 | 800 | 1100 |
| 70 | 450 | 700 | 950 |
| 75 | 400 | 600 | 800 |
| 80 | 300 | 450 | 650 |
| 85 | 200 | 350 | 500 |
| 90 | 150 | 200 | 300 |
| 95 | 50 | 100 | 150 |

1/ Percentage of full sunlight reaching the ground at midday during the growing season.
2/ Based on summation of diameters.
3/ Western white pine, western larch, Douglas-fir, ponderosa pine, and lodgepole pine are considered to be small-crowned trees. Grand fir, western hemlock, western redcedar, Engelmann spruce and alpine fir are large-crowned trees.

Summation of diameters is simply the addition of diameters at breast height per acre. This measure can be obtained from cruise data if they contain a tally of all stems.1/

The principal use of table 1 is to determine how heavy a cut to make in any given stand to obtain a desired light intensity. To illustrate, a partial cutting is to be made in the following stand:

| D.B.H. Class | Number of trees per acre | | | | Summation of diameters per acre | |
|---|---|---|---|---|---|---|
| | White Pine | Douglas-fir | Western hemlock | All Species | White pine & Douglas-fir | All Species |
| Inches | Number | Number | Number | Number | Inches | Inches |
| 2 | | | 10 | 10 | | 20 |
| 4 | | | 12 | 12 | | 48 |
| 6 | 2 | | 13 | 15 | 12 | 90 |
| 8 | 4 | | 15 | 19 | 32 | 152 |
| 10 | 6 | | 12 | 18 | 60 | 180 |
| 12 | 8 | | 11 | 19 | 96 | 228 |
| 14 | 14 | 1 | 8 | 23 | 210 | 322 |
| 16 | 17 | 2 | 3 | 22 | 304 | 352 |
| 18 | 18 | 3 | 2 | 23 | 378 | 414 |
| 20 | 20 | 1 | 1 | 22 | 420 | 440 |
| 22 | 12 | 1 | 1 | 14 | 286 | 308 |
| 24 | 8 | | 1 | 9 | 192 | 216 |
| 26 | 4 | | | 4 | 104 | 104 |
| 28 | 1 | | | 1 | 28 | 28 |
| 30 | 1 | | | 1 | 30 | 30 |
| All classes | | | | | 2152 | 2932 |

As the small-crowned species, white pine and Douglas-fir, make up 73 percent of the total summated diameters, the average light intensity is estimated from column 4 of table 1. The equivalent light intensity for 2,932 inches of diameter per acre is 25 percent (to the nearest 5 percent). If a light intensity of 40-50 percent is needed for ribes suppression, 2100-1650 inches of diameter per acre (table 1) must be left after cutting. A trial marking is made in which all the Douglas-fir, the larger hemlocks, and poor-vigor white pines are marked for cutting, with due attention given to even spacing of trees to be left. This results in a "cut" tally per acre as follows:

1/ Cruise data need not be broken down by diameter classes as completely as shown in the stand table on this page. If the data contain a tally of material below 6 inches and from 6 inches to merchantable diameter, summation of diameters may be obtained for these two broad classes by multiplying the number of trees in each class by the average diameter of the class.

| D.B.H. Class | Number of trees to be cut per acre | | | | Summation of diameters per acre |
|---|---|---|---|---|---|
| | White pine | Douglas fir | Western hemlock | All Species | All Species |
| Inches | Number | Number | Number | Number | Inches |
| 14 | 8 | 1 | | 9 | 126 |
| 16 | 7 | 2 | 3 | 12 | 192 |
| 18 | 8 | 3 | 2 | 13 | 234 |
| 20 | 5 | 1 | 1 | 7 | 140 |
| 22 | 3 | 1 | 1 | 5 | 110 |
| 24 | 2 | | 1 | 3 | 72 |
| 26 | 2 | | | 2 | 52 |
| 28 | 1 | | | 1 | 28 |
| 30 | 1 | | | 1 | 30 |
| All classes | | | | | 984 |

The summation of diameters of trees to be cut is 984 inches. Therefore, 1948 inches of diameter will be reserved. The light intensity beneath this residual stand is shown by table 1 to average about 45 percent, which is within the range of light intensities desired.

If the trial marking had resulted in a light intensity greater or less than the desired intensity, table 1 would provide a guide for increasing or decreasing the cut to arrive at the desired intensity.

The table also provides a means of estimating light intensities in cutover stands. This is frequently useful in classifying residual stands with respect to probable success or failure of regeneration of desired species.